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ABSTRACT

Two focuses of a discussion of literacy and vocational competence should be the need for a more profound understanding of literacy and the relevance of that understanding for studying reading in vocational settings. A developmental model of the acquisition of literacy considers reading a second signaling system for speech. People who become literate learn to perform tasks with written language they previously could perform only with the spoken language. A second view of the written language points out that it differs from spoken language in two critical ways: it is permanent, and it may be arrayed in space. Written language can be consulted as an "external memory" and makes possible reading-to-do and reading-to-learn tasks. An exploratory study using reading-to-do tasks developed a job reading inventory to (1) identify the reading tasks performed in jobs and (2) determine the level of general reading skill needed to perform them. Results showed a strong relationship between reading ability and ability to perform job-reading tasks. The inventory approach remains unvalidated. A sound theory of literacy in vocational settings must antecede establishing minimal competency levels. (Questions and answers are appended.) (YLB)

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Occasional Paper No. 39

LITERACY AND VOCATIONAL COMPETENCE

by

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April 1978

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PREFACE

The National Center for Research in Vocational Education is pleased to present a lecture by Dr. Thomas G. Sticht, Associate Director, National Institute of Education, entitled "Literacy and Vocational Competence."

Dr. Sticht discusses the implications for vocational education as they relate to the lack of functional literacy of many high school students. In addition, he depicts the ways and means by which vocational education R & D can be responsive to students who are functionally illiterate.

Dr. Sticht is Associate Director for Basic Skills in the National Institute of Education. Prior to this he was a Senior Staff Scientist with the Human Resources Research Organization (HumRRO) Western Division in Monterey, California. In the Spring of 1975 he was a Visiting Associate Professor of Education at the Harvard Graduate School of Education. Dr. Sticht also has been a NASA Post-doctoral Fellow at the University of Pittsburgh, and has taught at the University of Louisville, at Monterey Peninsula College, and at Monterey Institute of Foreign Studies. For 10 years Dr. Sticht has directed R & D projects in basic skills. A major part of this work involved the design of a job-related reading program for the U.S. Army. This R & D program is described in a recently published book entitled *Reading for Working: A Functional Literacy Anthology.*

Dr. Sticht is the senior author of a recent text entitled *Auding and Reading: A Developmental Model.* He is also the senior editor of a forthcoming volume entitled *Reading and Readability Research in the Armed Services.* He is a member of the Editorial Board of the *Journal of Reading Behavior* and is Chairperson of the Basic Education and Reading Committee of the International Reading Association. He received his B.A., M.A., and Ph.D. in Psychology from the University of Arizona.

On behalf of the National Center and the Ohio State University, I take pleasure in presenting Dr. Sticht's lecture, "Literacy and Vocational Competence."

Robert E. Taylor
Executive Director
The National Center for Research
in Vocational Education

LITERACY AND VOCATIONAL COMPETENCE[1]

Today there is much concern that many of our high schools may be graduating thousands of students whose literacy skills are so low they will be barely able to function in society. This concern stems from stories that occur frequently in the popular press which refer to court cases wherein students with high school diplomas suddenly discover they cannot read well enough to get a decent job, so they sue their school for not properly educating them. Additionally, reports from various surveys, national assessments, and major government studies say that millions of adults, including young adults right out of high school, are "functionally illiterate"; they cannot fill out forms, use maps, read reference books well, write a check correctly, and so on. And as for those students who are functionally literate, the results of many tests for selecting students for higher education have shown a precipitous decline over the last decade.

The Call for Minimum Competence

Under the weight of public criticism, fueled by the many reports of student incompetence, even after twelve years of education, the state boards of education of over half the nation's states have initiated efforts to establish "minimum competency" standards to prepare students with the literacy skills needed to cope with the world of work, home, and community outside the school.

In the pursuit of minimum competency, many have discovered that it is not at all easy to specify what kinds of literacy tasks people encounter outside of school, nor to identify a "level" of competence which might be considered "minimal" yet "functional" enough to be set as a standard for achievement.

Literacy for Vocational Competence

One of the aims that citizens want from their schools is to prepare students with the literacy skills that are needed to be able to get, hold, and achieve in a job. Most aspire to more than unskilled labor for their children. They want the schools to develop literacy skills needed for access to responsible, well-paying jobs. These are not necessarily jobs for which extensive higher education is required, but jobs for which a good high school education—that's twelve years—should prepare one for: a good trade, a craft, or a white-collar managerial job.

But parents are not the only ones who want schools to develop literacy skills adequate for good employment. Employers want competent help; and many adults who have dropped out of school, or who did not earlier have access or the means to get an education, return to adult basic education

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[1] The findings and opinions expressed in this report do not necessarily reflect the position or policy of the National Institute of Education or the U.S. Department of Health, Education, and Welfare. The research reported herein was conducted while the author was Senior Staff Scientist with the Human Resources Research Organization, Western Division, Carmel, California.

classes and seek to acquire the literacy skills so necessary for finding well-paying employment. Typically, these adults want to acquire work-relevant literacy skills as fast as they can—time is much-needed income to them.

Not infrequently, however, these adult students are asked to participate in a curriculum geared not to the literacy tasks encountered in the world of work, but rather to the world of the school. They are asked to study geography, social studies, history, and other courses leading to the taking of the High School Equivalency examination. Small wonder then that, upon encountering the school-oriented curriculum, where teachers many times regard them as big children, the undereducated adults drop out of school at a disalarming rate before they have developed the skills they need to move themselves up in the occupational peaking order.

Understanding the Nature of Literacy

Though the many activities underway to develop minimum literacy standards have good intentions, they suffer from the lack of a very clear understanding of what is meant by literacy, and from a lack of information about the ways in which literacy skills are used in various vocational settings. Evidence abounds which indicates that there is considerable lack of consensus as to what literacy means, and how knowledge, reading, and literacy interrelate. For example, in a recently completed project for the United States Office of Education, Adult Education Division, literacy was conceived of as being "composed of an application of the communications (reading, writing, speaking, listening), computation, problem solving, and interpersonal relations skills to the general areas of occupational knowledge, consumer economics, community resources, government and law, and health" (Northcutt, Selz, Abelton, Nyer, & Hickok, 1975, p. 44). In this case, literacy is not restricted to the traditional skills of reading and writing, but is extended to include oral language skills and even interpersonal skills! Furthermore, literacy includes five general areas of knowledge, too. While it seems reasonable to me to distinguish between skills and knowledges, I believe that the failure to restrict the definition of literacy skills to tasks involving reading and writing clouds the natural hierarchical relationships that exist between oral and written languages, in a developmental sense, which could be useful in developing assessment tests which provide both assessment and diagnostic information. I will discuss this developmental aspect of literacy further, later on.

Though, as I have said, the distinction between knowledge and skills made by the USOE study seems valuable to me, this project has resulted in a set of "functional" literacy tests which fail to distinguish between skills and knowledges. Thus, for instance, when people fail to answer "reading" items, there is no way to know whether this failure is due to poor reading skills, or lack of the relevant knowledge, or both (or neither, for that matter). Yet, important conclusions about reading are:—based upon such ambiguous data—"About one-fifth of the sample could not read an equal opportunity notice well enough to identify a verbal statement which defined its meaning" (Northcutt et al., 1975, p. 44). In this study, one-fifth of this adult sample would suggest that more than 20 million adults have a serious reading problem! Today, the results of this study are being used to design curricula in more than 100 adult literacy programs.

A major difference between the perspectives of educational researchers such as cited above and a large number of other researchers, in regard to the nature of reading and hence the nation's "reading problem" is stated succinctly by Jenkins and Liberman (1972):

> At all events the "reading problem" as we know it would not exist if, in dealing with language, all children could do as well by eye as they do by ear (p. 1).

According to this view, in which writing is construed as an alternative input display to speech, the "reading problem" is one of getting to learn the knowledge of sight-sound correspondences, and to develop skill in using this knowledge to the point of being able to comprehend printed messages with the same degree of accuracy and efficiency as the children could comprehend the message if it were presented in spoken form.

From the foregoing, it seems that many researchers have wished to limit the concept of literacy to that of an alternative, graphic, method of representing the spoken language (writing) and learning to comprehend the graphic representation of language (reading) by eye as well as one could previously comprehend the acoustic representation of language by ear.[2]

While educators and lay persons have also included the notions of "reading as a substitute for listening to spoken language" within their concept of literacy, they have further expanded the meaning of "reading" to include the knowledge of "general" vocabulary and concepts, and the learning of new skills for obtaining information from graphic displays, which involve both linguistic and non-linguistic features (tables, graphs, maps, etc.). Thus, as in the USOE study above, and in various "reading" tests, students can score low in "reading" because of lack of specific vocabulary or other knowledge, lack of skill in processing information from special graphic displays, or lack of skill in languaging by eye as well as they can by ear (as well as other factors such as low motivation). Furthermore, "reading" training programs usually go well beyond simply teaching the encoding and decoding of written language to comprehend what one already knows in the oral language, and include the teaching of specific knowledges in various content areas. To term all of this as "reading" training confounds the teaching of content knowledge, which must be taught by oral language or "hands-on," "show-and-tell" experiences, with the development of facile skill in decoding and encoding of the written language.

A General Model of the Development of Literacy Skills

Because of the confusion regarding "reading" and "literacy," with its frequent detrimental effects on the assessment, teaching, and researching of reading, we have found it useful to conduct research and development projects on the design of literacy training programs following the conceptual guidance of a simple model of the major components and processes involved in the development of literacy skills.[3]

Figure 1 presents the developmental model of literacy in schematic form.[4] Briefly, the model recognizes that when a child is first born, he or she has certain basic adaptive processes for adapting to the world around them. These basic adaptive processes include certain information processing capacities for acquiring, storing, retrieving, and manipulating information. This stored information processing capacity forms a cognitive content which, in its earlier forms, is pre-linguistic (Figure 1, Stage 1). After some time, the child develops skills for receiving information representing the

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[2]See Kavanagh and Mattingly (1972) for a farily representative sample of researchers who participated in the large-scale Project Literacy effort and in other efforts treat reading as "decoding print to speech."

[3]I am indebted to Lynn Fox, Diana Welty Zapf, Robert Hauke, and John Caylor for their outstanding work as members of the research team at HumRRO who conducted the research reported here.

[4]See Sticht, Beck, Hauke, Kleiman, & James (1974) for an extended discussion of the model and related research.

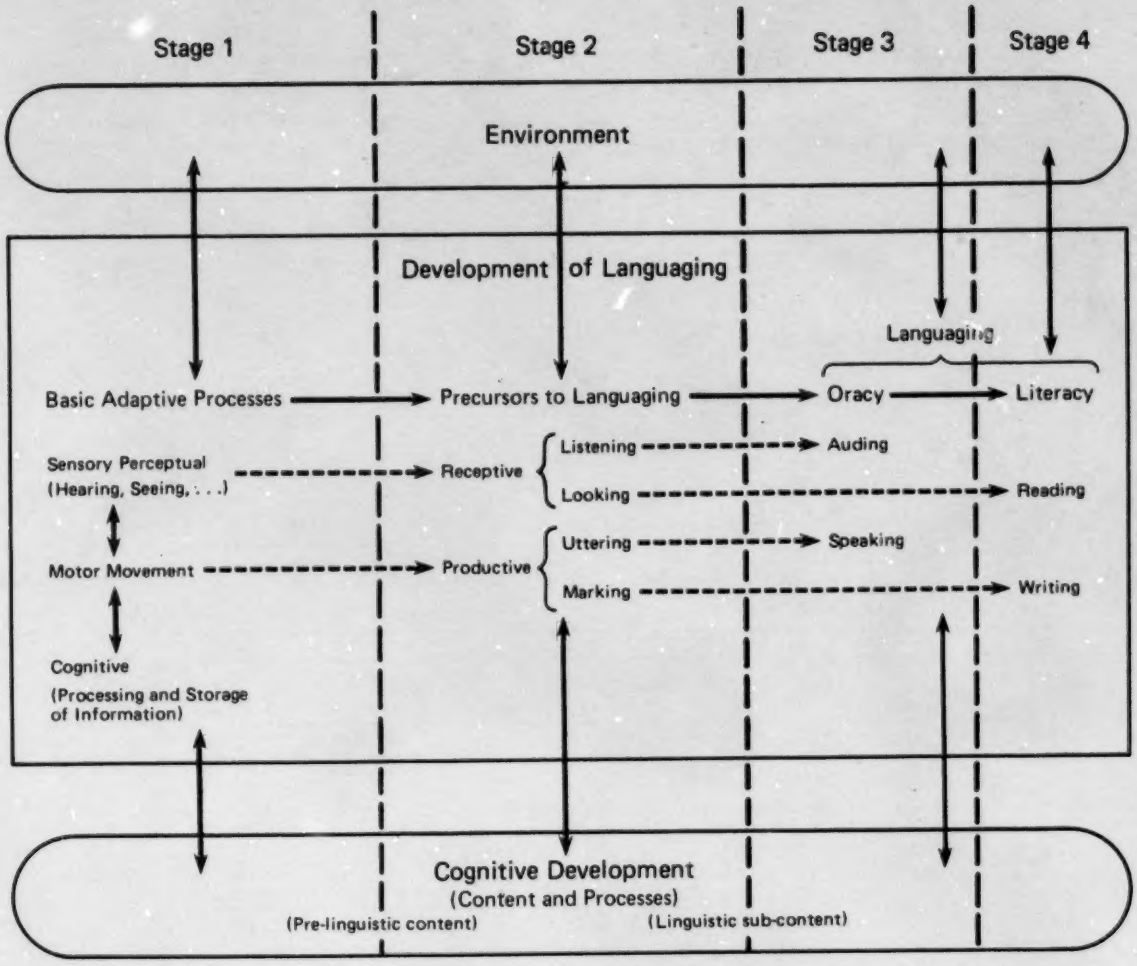

Figure 1. Overview of the developmental model of literacy.

cognitive content of others, and for representing his/her own cognitive content to others. This is accomplished through the specialization of the information processing activities of listening, looking, uttering, and marking (Figure 1, Stage 2). The specialization is one of using these skills for the express purpose of externally representing one's own thoughts for others to interpret, and forming internal representations of the expressions of others' thoughts that they make. More specifically, the particular specialization of present concern is the representation of thoughts by the use of conventionalized signs (words) and rules for sequencing these signs (syntax) in speaking and auding (listening to speech in order to language) (Figure 1, Stage 3).

Finally, if the child is in a literate society, he/she may acquire the specialized looking and marking skills of reading and writing. For present purposes, we presume that we are talking about the "typical" case in our literate society, and assert that children typically learn to read and write (Figure 1, Stage 4).

A further aspect of the developmental model, is that it holds that the development of the oracy skills requires the development of the cognitive content through intellectual activity which we call conceptualizing ability. In other words, the development of the oracy skills of speaking and auding follows and is built upon a pre-linguistic cognitive content and conceptualizing ability. Said plainly, the child must have something to think about before the need for a language ability for sharing thoughts can and needs to arise. It is important that it be understood that this early, pre-linguistic cognitive content, or knowledge, is what will form the foundation for the acquisition of new knowledge over the lifetime of the person. Furthermore, much of this knowledge will remain personal, and will not be represented in language for communication to others. Nonetheless, such personal, tacit knowledge, which will include perceptual learnings, and general knowledge of "how the world works," will be absolutely necessary for learning to comprehend the spoken, and later the written language. This reflects the fact that language is selective in the features and concepts chosen to be represented. We may think of language as producing a verbal figure, which can only be comprehended in terms of its relationship to a non-linguistic conceptual ground of "world knowledge." A simple illustration of the role of personal or "world knowledge" in vocational literacy training is seen in the recommendation to give students "hands-on" experience with equipment, procedures, and materials they are going to read about before they read about them. This will provide "experiential" or "world knowledge" which will permit a "deeper" comprehension of the words and concepts they read about in vocational literacy training materials.

A final aspect of the model is that it asserts that the literacy skills utilize the same conceptual base (cognitive content, conceptualizing ability, knowledge) as is used in auding and speaking, and the same signs (words) and rules for sequencing those signs as is used in the oral language. Notice that this is an assertion based upon the developmental sequence, i.e., the literacy skills are built upon existing oracy skills as the end of a developmental sequence. This does not mean that once literacy skills are acquired, they do not contribute anything new to knowledge or language capability; clearly they do. What is asserted is that, in the typical case, when the literacy skills are initially acquired, they are essentially to be construed as a second way of utilizing the same language system the child uses in speaking and auding. Presumably this is what Jenkins and Liberman refer to as being able to use language by eye as well as it is used by ear. This conception of literacy restricts the term to the use of the written language by reading and writing. Oral language skills, problem solving skills, content knowledge, etc., may be used in connection with literacy skills, but they are not literacy skills themselves.

Closing the Language by Ear and by Eye Gap

As stated above, one function of the written language is to serve as a second signaling system for the language used in speech. The developmental model discussed above presents a detailed

model of the relationship of written to spoken language. Based on this model, one goal for training reading competence is to help the person to become as effective and efficient in using the written language as she/he is at using the spoken language.

Though this seems to me like a very basic relationship to be explored if one is interested in understanding the acquisition of ability to language by eye as well as by ear, it turns out that there is, to my knowledge, absolutely no research specifically designed to find out (1) how well non-literates can comprehend language by ear, and (2) how much time they require to learn to comprehend language by eye as well as they do by ear. In other words, how long, typically, does it take to "crack the code?"

In the absence of well-designed studies which might reveal something of the closing of the "gap" between languaging by ear and by eye, Sticht et al. (1974) reviewed some forty-four studies which measured how well subjects at different grade levels could comprehend messages presented in spoken versus written form. Figure 2 summarizes this review and shows, for each grade level, the proportion of studies in which auding was found superior to (A> R), equal to (A = R), or inferior to (A < R) reading. It should be cautioned that these studies represent a wide variety of methods, messages, difficulty levels, response modes, etc.

With these concerns in mind, the data of Figure 2 suggest that, clearly, children have not learned to comprehend by reading as well as they can comprehend by auding by the third grade. Learning to language by eye as well as one can language by ear may require as long as seven years, since it is at the seventh grade level where one has a fifty-fifty chance of finding studies showing auding > reading, and studies showing auding $\leqq$ reading.

Consistent with the foregoing, and using students in an adult literacy program, Sticht & Beck (1976) found that it was not until students scored at the sixth to eighth grade level on a standardized reading test that parity was found between auding and reading.

Comparisons of silent reading rates to typical auding rates provide additional evidence to suggest that it is around the seventh or eighth grade level that the reading decoding process typically achieves the same degree of automaticity as is involved in auding. Data from the National Assessment of Educational Progress: Reading Rate (see Sticht et al., 1974, p. 95) indicate that the silent reading rate for thirteen-year-olds (seventh and eighth graders) is around 175 wpm (words per minute). This is very nearly the same as the average oral reading aloud rate of professional newscasters and readers for the blind. If 175 wpm is regarded as a typical auding rate (because it is the rate professionals read aloud to be auded), then the silent reading rates of thirteen-year-olds (seventh graders) closely match the auding rates required when auding newscasts and similar formal spoken presentations. This might be construed as suggesting that reading and auding are operating with comparable degrees of automaticity of decoding in reading requires extensive practice over an extended period of time. This is a particularly important point for adult literacy training. It suggests that we must anticipate expending considerably more time and effort than presently found in most tutoring or classroom reading training programs, which typically last only some 50 to 100 or 200 hours, to develop parity in auding and reading skills.

Written Language as a Tool for Cognitive Task Performance

As discussed above, one aspect of becoming literate is for one to learn to use the printed code with the same efficiency as he/she uses the spoken code in auding, i.e., to read efficiently.

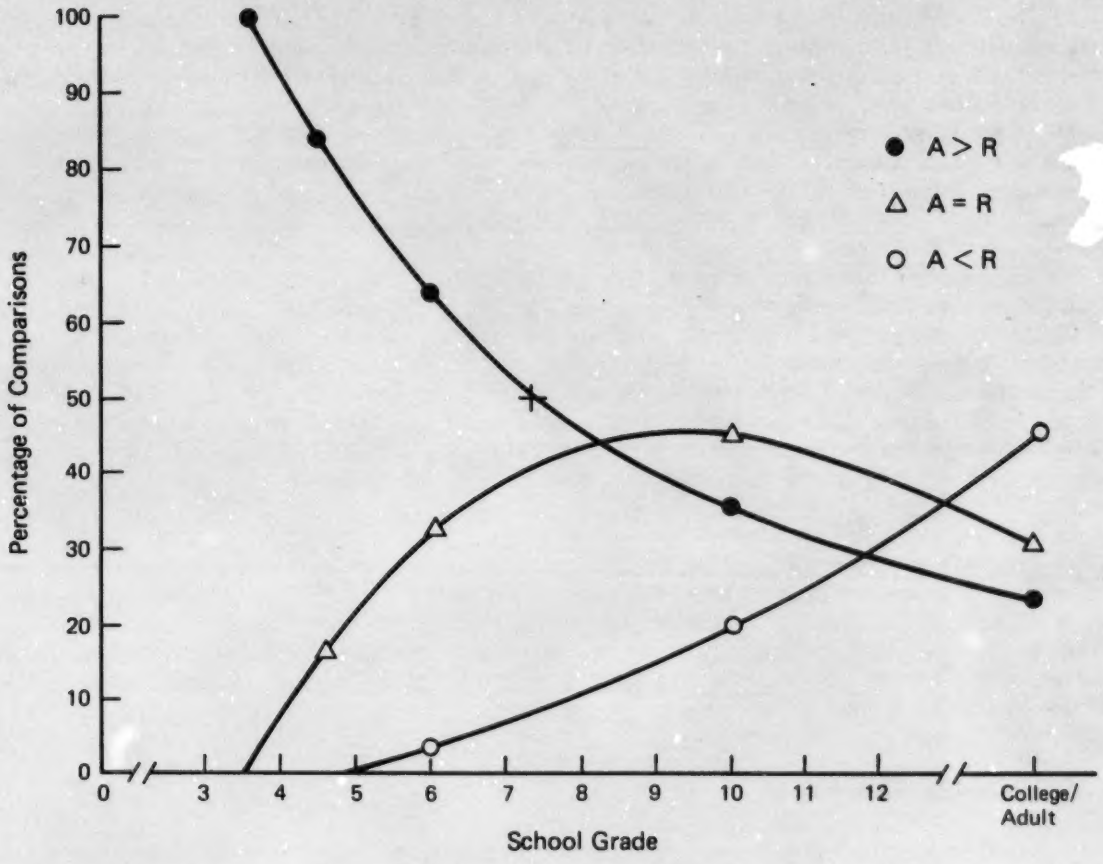

Figure 2. Comparison of auding and reading performance at five schooling levels.

A second aspect of achieving literacy involves learning to use the printed medium for performing tasks which demand a variety of information processing skills in addition to reading. Many of the tasks will require writing; most will require repeated reading of some materials; and still others require reading while examining non-linguistic displays. It is in the performance of various tasks in which written materials are used that the unique properties of writing, and the printed media in general, appear to contribute most to the development of "literacy," as contrasted with "reading."

The unique aspects of written messages which set them apart from spoken messages are (1) they are more-or-less permanent; and (2) they can be arrayed in space. Because written messages are permanent (i.e., not occurring on-line as in a live speech) and can be arrayed spatially (both on a page and as a volume of pages when in book form) they can be surveyed so that readers can mobilize such related knowledge as they may have to relate the information in the text to what they know. Because the text is more-or-less permanent, it is referable, i.e., the reader can flip back and forth to preview or review; the text can be returned to at a later date for rehearsal of what was previously read.

A particularly unique aspect of reading, as distinct from auding, arises from the fact that the printed word can be arrayed spatially. Thus we find figures and graphs with labeled axes and internal parameters; charts and tables; and illustrations with "call-outs" for identifying parts of the illustration. At times comprehension of what is being read is contingent upon being able to comprehend the accompanying figure, table, etc. At other times, performance of some task, such as repairing a motor vehicle, may require the reading of language arrayed in a special "trouble-shooting" table. In such cases, if the structural properties of the table are not well-understood, reading comprehension may be disrupted, especially if it is necessary to combine information from different parts of the table.

Though there are certainly other tasks people perform with printed materials, I think the ones discussed above are sufficient to make the point that much of the acquisition of literacy is not simply learning to read, i.e., learning a substitute language system for the oral language system. Rather, a large part of learning to be literate, and perhaps the most important part for acquiring higher levels of literacy, is learning how to perform the many tasks made possible by the unique characteristics of printed displays, their permanence and spatiality.

Vocational Reading Research

The concepts regarding the nature of literacy presented above have been developed in the course of over a decade of research to understand reading as an information processing skill used in vocational settings. Here I will draw upon a portion of that research to illustrate the relevance of the theoretical analysis given above for studying how literacy skills are engaged in vocational competence.

Reading as a second signaling system for auding. The first research to be discussed was concerned with whether personnel in three Army jobs tend to use reading as a supplement to auding, and whether this changes as a function of reading ability. This is related to that aspect of the developmental model presented above which holds that one important feature of reading is that it may serve as a second signaling system for auding.

In this research (Sticht, 1975), interviews were conducted with staff working in the Army as Cooks, Automobile Mechanics, and Supply Specialists. Personnel were interviewed who had reading skills, stated in reading grade-level equivalents of either grades 4 to 6.9, 7-8.9, or 9 years or greater. The personnel were interviewed at their job sites, and were asked to give five instances when, in the

last month or so, they had been performing a job task and had had to ask someone for information about the task. Since the people replied by speaking, the person received the information by auding. Thus we obtained up to five examples of the use of auding by personnel of three levels of reading ability.

A similar procedure was followed to obtain information about the use of reading. Personnel were asked for five instances from the last month or so when they had been doing some job task and had had to read something to complete the task.

The results of the interviews are given in Figure 3. There we have plotted the average percent of maximum possible citations given for each reading level group in each job. Since we asked for five citations of auding and reading, a score of 20 percent means that, on the average, only one citation was obtained. A score of 40 percent means that two citations were given, and so forth.

Statistical analyses and the data of Figure 3 indicate that for the Supply Specialist and Auto Mechanic a clear relationship exists between reading ability and the reported use of auding and reading skills—the more able the reader, the more likely he/she was to use the printed medium. For Supply Specialists, readers in the grades 4-6.9 reading groups gave only 30 percent of the maximum possible citations of use of reading, contrasted with nearly 65 percent of maximum citations for the group of readers in the grades 9+ range. For Auto Mechanic, the use of reading increased from 30 percent to 50 percent of maximum as a function of reading ability, while the data for the Cooks show a uniformly high citation of reading. As it turns out, the cooks use simple recipe cards daily, and hence were able to provide practically the full number of citations of reading requested.

Regarding the use of print as a second signaling system for speech, the data for Auto Mechanics and Supply Specialists clearly indicate that poor readers tend to use auding and reading to about the same extent, although auding is favored in these groups. With increasing reading skill, there is a trend for the use of reading to increase, while the use of auding decreases slightly (though with the small groups studied here, the decline in auding citations is not statistically significant). Notably, too, the poorest readers do not make up for their low usage of reading by an increased use of auding. Rather they simply operate with an overall lower level of seeking job-relevant information.

These data suggest that one of the consequences of developing skill in reading is that people can, and many times will, use this capability to add to the information they get by auding. Additional research with personnel in the Supply Specialist and Auto Mechanic's job indicated that if these personnel used job manuals while performing job sample tests, they performed more accurately than if they did not use manuals (Sticht, 1975, p. 54). If, by vocational competence, we mean the ability to perform job tasks with high degrees of accuracy, then these findings suggest that the acquisition of reading skill may serve to augment the seeking of job information over that which personnel do by auding, and that the propensity to seek job information from printed sources may pay dividends in terms of improved vocational competence.

The nature of job reading tasks. Our analysis of written language has indicated that it differs from spoken language in two major features: the written language is more or less permanent, and it can be arrayed in visual space. These features make possible the use of written materials for reference purposes, so that information does not have to be learned. Persons in non-school settings appear to use printed materials in such a "consultative" fashion to a much greater extent than they do as material to be learned. Furthermore, when used for learning purposes, the features of permanence and spatiality are drawn upon in various study strategies, such as preview/review (based on permanence) and outlining and underlining (based on the use of visual space).

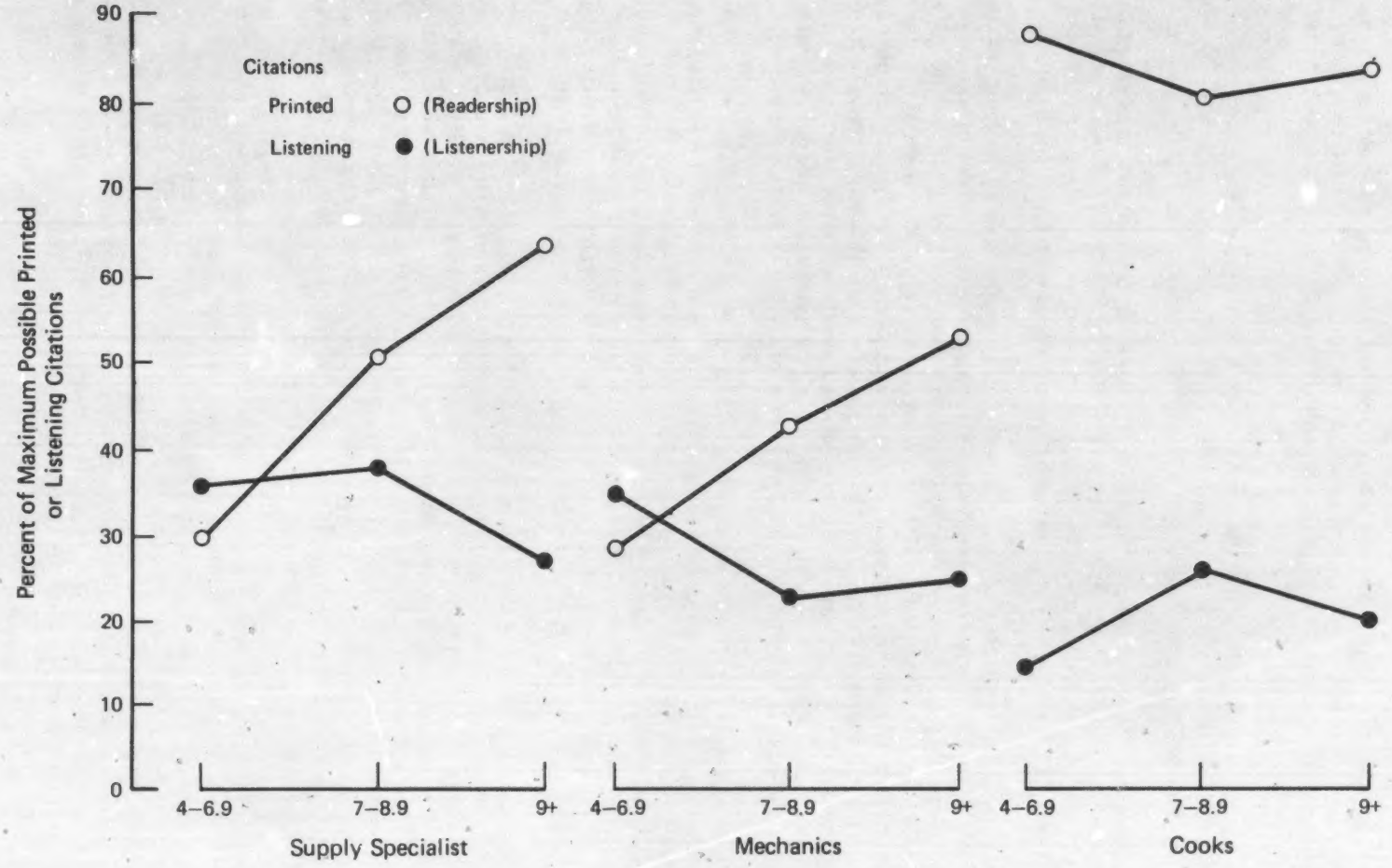

Figure 3. Citation of reading and listening information sources by reading ability level.

The features of permanence and spatiality permit two broad classes of reading tasks. In the first, information is looked up in order to do some task at hand and then may be forgotten. This I call a reading-to-do task. The point here is that the printed language is an external "memory" which can be consulted. Because the information is stored in the book, it does not have to be stored in the head. It can simply be looked up if needed again.

The second kind of general reading task made possible by the permanence and spatiality of printed language is reading-to-learn. Because the written language is permanent, it can be studied and the information can be learned for later use. As mentioned above, many study strategies may make use of the properties of visual space to enhance learning.

Information regarding the performance of reading-to-do and reading-to-learn tasks in job settings was obtained in interviews with some 180 Navy personnel in ten job fields and for three job roles: students, instructors, and active job performers (Sticht, Fox, Hauke, & Zapf, 1976). Personnel were interviewed at their school or job duty sites. An attempt was made to get one citation of one reading-to-do and one reading-to-learn task from each interviewee. Thus, for students, instructors, and job incumbents, we wanted 50 percent reading-to-do and 50 percent reading-to-learn tasks.

However, as Figure 4 shows, with increasing distance from the school setting, the proportion of performed reading-to-learn tasks which people could report in the last 24 hours decreased, and the proportion of reading-to-do tasks increased such that some three-fourths of the tasks obtained from job performers were reading-to-do tasks.

The fact that students who have just entered the Navy perform proportionately more reading-to-learn tasks is consistent with their role as students. In confirming what we would expect of students, the findings also suggest that, in many trades and skilled jobs, the cognitive demands of job training are likely to exceed those of job performing. This is so because reading is common to both reading-to-do and reading-to-learn tasks, while the latter makes additional demands on information processing strategies for learning from and with textual materials. The design of job training programs should reflect the requirements of the job as faithfully as possible to ensure that job training does not act primarily as a screening test which passes those with high verbal ability and well-developed strategies for learning from text—skills that may not be necessary for job performance. Excessive requirements for learning from textual materials should be avoided (job incumbents in the present research suggested that one-fourth to one-half of what they had to learn in entry level training was not needed to do their jobs!).

Figure 5 presents a framework which summarizes several additional categories of information obtained during the interviews with Navy personnel. In soliciting information about job tasks and job reading tasks, we attempted to find out something about the knowledge contexts supporting these activities. For instance, do job tasks which involve reading subtasks tend to be relatively unfamiliar tasks? Or, are they repetitive in nature? Have similar job tasks been performed? For reading tasks, we wanted to know whether or not this is the first time the person has read the material—or do workers tend to read repetitiously?—or in related areas to the reported reading task?

Answers to questions such as the foregoing reveal the extent to which job contextual or personal/tacit knowledge may be operating to facilitate reading comprehension. It also suggests the extent to which the reading skill is called upon to forge into new areas; to subdue "cognitive brushfires" in a variety of content domains. Jobs requiring such flexible use of reading skills may require more broadly developed bases of knowledge—more "general" education—than those in which reading is repetitive or in related areas for the most part.

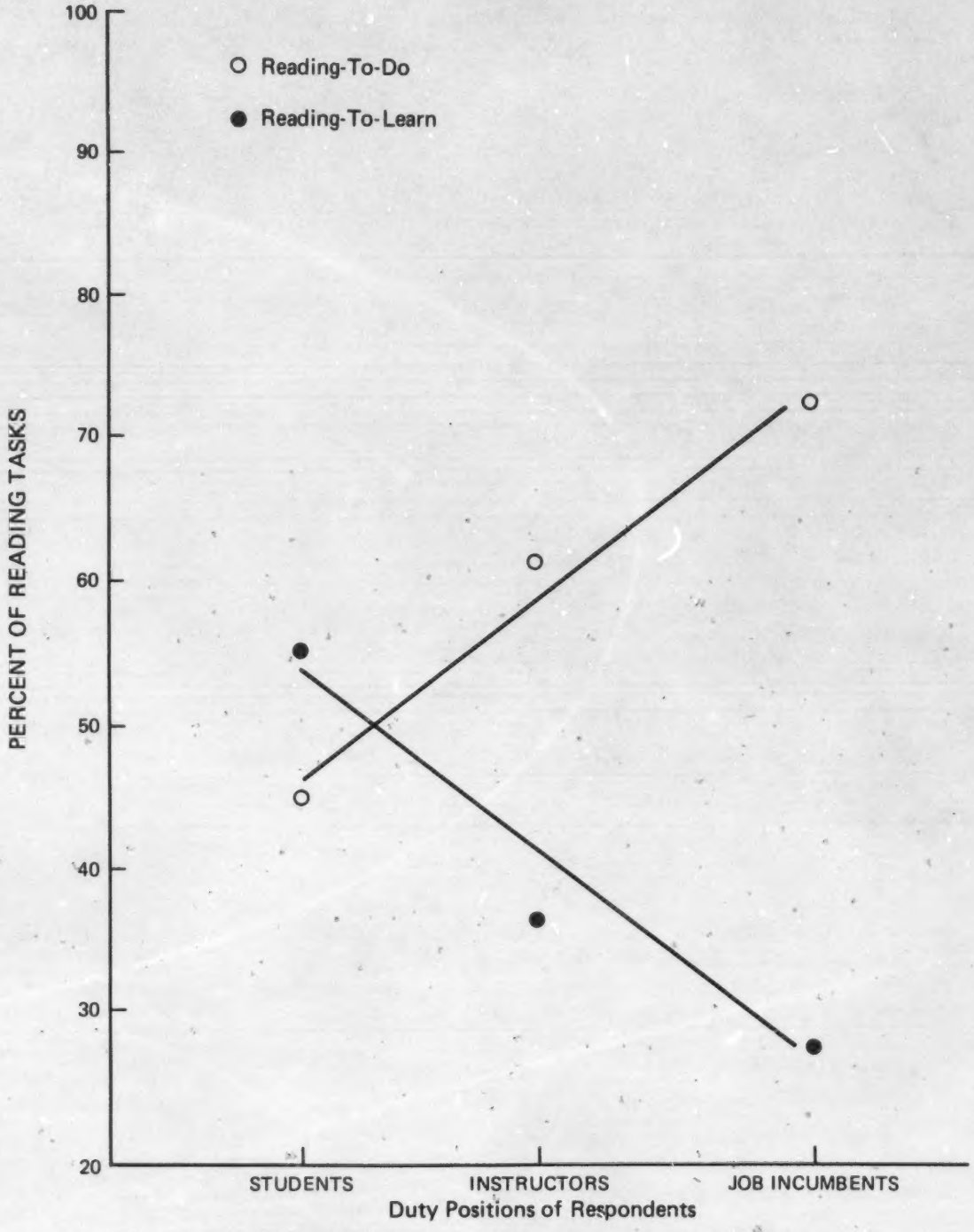

Figure 4. Percentage of reading tasks cited by three groups of Navy personnel in which the purpose of the reading task was to obtain information for doing a job (o) or to learn the information for future use (•).

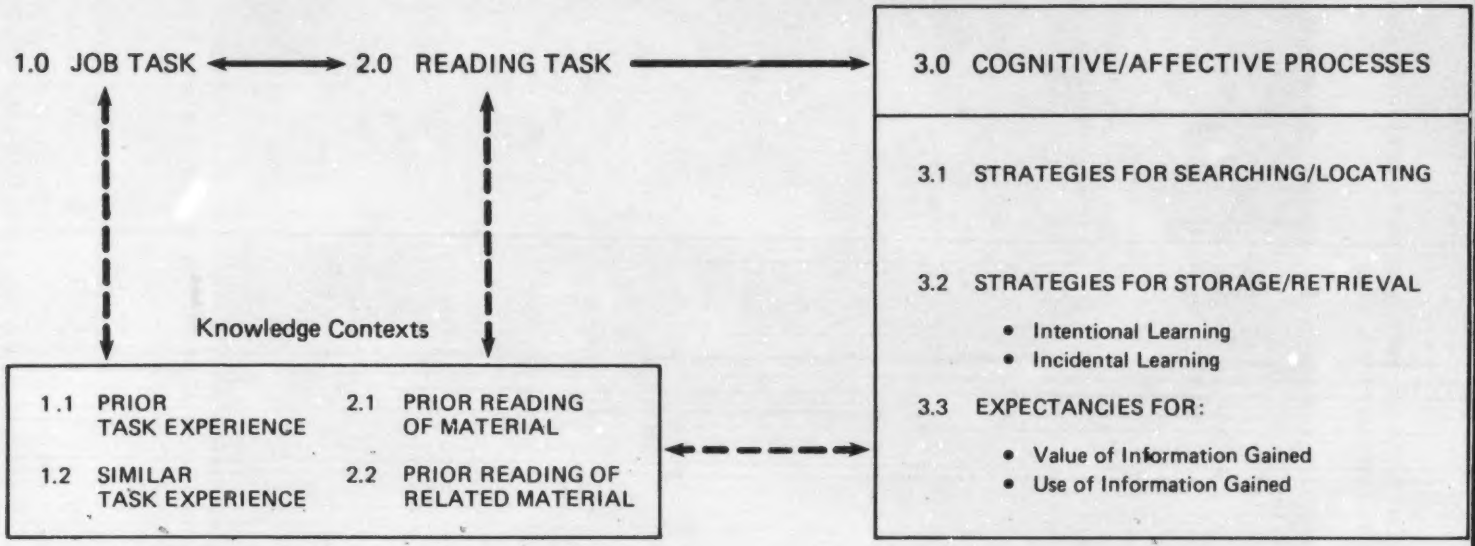

Figure 5. Major categories of information obtained from job personnel regarding previous experience with job tasks and job reading tasks, and some cognitive/affective factors involved in processing information from reading materials.

The cognitive/affective processes focus upon one of three major types of activities:

1. Those expected to be of primary importance for reading-for-doing tasks, in which the searching and locating of information plays a primary role.

2. Those expected to be of primary importance in reading-for-learning tasks; i.e., strategies for storing information in a retrievable manner.

3. Those processes which are somewhat like feeling states in experience and which create implicit expectations for the value of the reading task; (What are the consequences of a reading error?) or for the use of the information learned (Will it be used? When? How often?).

Detailed data for each of these categories of information can be found in the report by Sticht et al. (1976). Only summary statements will be given here.

The data regarding the knowledge contexts for job tasks and job reading tasks indicated that, for the most part, job related reading is used in conjunction with tasks which are of a repetitive nature, and are similar to other job tasks. Many of the reading tasks themselves are likely to be repeatedly performed in a cyclical manner: daily, weekly, etc.

It is perhaps due to the repetitive, homogeneous nature of job tasks and job reading tasks, that the effects of lower levels of literacy, and, conversely, the usually high levels of reading difficulty of materials in military jobs (cf., Sticht & Zapf, 1976) can be tolerated. There will be repeated opportunities for gaining experience in the performance of job tasks, including the reading and rereading of materials used in support of the job task.

Efficiency of reading may improve due to repeated reading of a homogenous set of materials concerned with a restricted body of knowledge. This possibility is suggested by the information obtained regarding the cognitive processes for searching and locating information, which indicated that tables of contents and indexes were used for only about 25 percent of the tasks for which they were applicable. This was determined by requesting personnel to obtain the materials used in performing reading tasks and to show the interviewer the exact material which had been read. The interviewer noted whether the person used the tables of content, the index, or whether the person simply "flopped through" materials to locate the information. Indeed, the latter strategy accounted for three-fourths of the search/locate strategies. In part, this reflects the repetitive nature of job reading mentioned above.

Information bearing on the strategies personnel use for storage/retrieval of what they read was obtained for reading-for-doing and reading-for-learning tasks separately.

Concerning the reading-for-doing tasks, information was sought which would reveal whether or not the information looked up during the course of performing a job task was likely to have been learned. We also sought to find out if information which had been learned during the performance of the reading task had been intentionally learned, using some strategy for learning, or if it had been incidentally learned simply by reading and doing the job task.

To determine if information read during a reading-to-do task had been learned, personnel were asked: "If you were doing this job task again tomorrow, would you read this material again tomorrow?" For three-fourths of the tasks the answer was "yes." In part, this represents the large number of tasks in which reading is an inherent part of the task: filing a document, filling out a form, computing an index number from tabular data, etc.

One quarter of the reading-for-doing tasks was reported to not require rereading the next day because the information had been learned. Of this learning, some 70 percent of the information was reported to have been learned just by reading the job materials and doing the job task. This we called incidental learning. In such learning, either most people could not recall any particular learning strategy, or the information processing involved in extracting information from texts and/or applying it provided sufficient cognitive transformation for learning to occur. Whatever processes might be involved in this type of incidental learning during reading-for-doing task performance, it is not the method of choice when the task is reading-for-learning.

In the latter tasks, three-fourths of the tasks were reported to have involved special study techniques, while only one quarter of these tasks was reportedly learned simply by reading, as in the reading-for-doing tasks. Table 1 summarizes the results of questions to determine the nature of the various learning strategies people reported using. The 147 open-ended responses were grouped under four categories of learning strategies.

- **Reread/Rehearse (R/R):** Involves repeating the processing of information taken from text, with minimal elaboration or transformation.

- **Problem Solve/Question (P/Q):** Involves answering text questions, solving problems in texts; activities which stimulate a search through materials for obtaining specific answers.

- **Relate/Associate (R/A):** Involves use of mnemonics; discussion of material; associations of new information with other information; elaborations.

- **Focus Attention (F/A):** Involves activities which reduce the amount of information in some manner; e.g., underlining key points, outlining, taking notes.

The most frequently reported strategy was to reread the material. This accounted for almost 25 percent of the total responses. Strategies which focus attention by reducing the information to be reread or studied were the least frequently reported, accounting for only 13 percent of the total. The relate/associate strategy category received the greatest number of different entries, though some may disagree with the present sorting. For instance, is "discuss with someone" an R/A or R/R strategy? Here it was sorted into the R/A category simply because it was imagined that such discussion would add elaborative encodings to the information. No doubt, all R/A includes some R/R—nor can any of these categories be considered as mutually exclusive of all the other types of strategies. The category label is meant to reflect a relative weight for the type of strategy named.

Overall, the open-ended responses obtained during the discussion of reading-for-learning tasks reveal a wide range of specific learning techniques, many of which have never formed the basis for research or learning in the psychologists' laboratories. The findings suggest that much "text learning" involves additional information sources, such as diagrams, movies, tape recorders, and even other people with whom materials may be discussed. The study of ecologically valid learning strategies is required if we are to fully understand what kinds of competencies people draw on to accomplish learning goals.

Functional Contexts for Reading

As mentioned earlier, we wished to better understand the general cognitive/affective processes involved in the performance of work-related reading tasks. One such ill-defined area of interest is the expectancies people have for why they are doing what they are doing, what its value is, and how

TABLE 1

Learning Strategies Used in Reading-to-Learn Tasks

REREAD/REHEARSE (R/R)

	# Responses
Reread/repeat	34
Memorize by repetition	7
Preview/then read	4
Copy verbatim in writing	2
Record on tape, listen to tape	1
Teach to someone	1
No. of Responses:	49
Percent of Total:	34%

RELATE/ASSOCIATE (R/A)

	# Responses
Use pictures/diagrams & relate to text	15
Discuss with someone	4
Associate to other information	3
Listen to lecture	3
Use mnemonic device	2
Make drawings	2
Use other reference materials	1
Watch demonstration	1
Relate notes and book	1
Relate to previous work	1
No. of Responses:	33
Percent of Total:	23%

PROBLEM SOLVE/QUESTIONS (P/Q)

	# Responses
Practice problems	21
Check problems against book	8
Take test/answer questions	7
Review questions/answers in text	6
Use study guides	1
No. of Responses:	43
Percent of Total:	30%

FOCUS ATTENTION (F/A)

	# Responses
Take notes/study notes	12
Pick out key points	3
Use outline	1
Underline	1
Use study schedule	1
No. of Responses:	18
Percent of Total:	13%

TOTAL NO. OF RESPONSES: 143

they will use what they are learning. The expectancies are frequently implicit, and are made explicit only in inquiry. Several indirect indicators of implicitly held expectancies were incorporated into the survey of work-related reading.

Estimates of the perceived value of reading were obtained by asking people what they thought would happen if they made a mistake in doing their job because they made a reading error. Would it only affect them? or would there be some direct effect to the Navy system—a cost in time, material, etc.? Our notion here was to find out if people even perceive a link between their reading behavior and some possible consequence for the job.

The results of 443 responses indicated that in 29 percent of the cases, personnel felt that a reading error would affect only themselves. Generally this would mean some type of verbal reprimand. The major consequence for the Navy would be loss in time (24 percent), with loss of time plus materials being the next most frequent consequence of a reading error (15 percent).

For the most part then, Navy personnel see some consequence, and thus, we would say, some value for their reading. There are perceived contingencies between the act of reading and the functioning of the Navy as an operational system. Reading thus has a perceived functional value.

Expectancies for the use of information gained from reading were obtained with respect to the reading-for-learning tasks. A direct question was asked: What is your reason for reading to learn the job information? For 115 reading-for-learning tasks, 47 percent were reported to have been performed to prepare for a test or because it was required. This was primarily due to responses by students and job incumbents, many of whom must take correspondence courses and pass final course exams to get promoted. About 80 percent of the instructors' responses were that they read in order to teach the material. Thus, as perhaps is true in the civilian world, reading-for-learning tasks are motivated in large part by system requirements for testing or certifying as qualified for advancement to some next stage of development.

Additional insight into the perceived uses of what was learned in reading-for-learning tasks was obtained by asking respondents: How long do you have to remember the information before you first use it? And, How often do you expect to use the information that you learned?

Results indicated that more than half of the reading-for-learning tasks provided information which personnel expected to use within twenty-four hours, while 90 percent of reading-derived information was expected to be used within thirty days. Over half of the tasks resulted in information which personnel estimated they would be using daily, with 75 percent providing information estimated to be used every month.

Generally then, these findings suggest that the reading-for-learning tasks were perceived as being performed for a definite purpose, that the information learned would be used relatively soon and would be used repeatedly, and that reading errors could lead to serious consequences both for the person and for the Navy as an organization. These expectancies provide a functional context in which reading is an instrumental act for acquiring information which will be used (or so it was thought; remember that reading for learning was reported more by entry level students than anyone else, and that experienced job performers estimated that one-fourth to one-half of what they had learned in job training was irrelevant to their jobs!).

The motivating force of functional contexts can be used in the design of vocational reading programs to provide basic skills training to students whose academic preparedness is inadequate. When vocational literacy training incorporates job-related reading tasks, students may perceive a

functional use for literacy and will frequently be motivated to learn to read when traditional, "general" literacy programs fail to engage them (cf., Sticht, 1975, for an example of a job-related reading program).

Identifying Reading Demands of Jobs

The research reviewed above clearly shows the importance of reading in job training programs and in job performance. The identification of reading-to-learn and reading-to-do tasks provides a rough indication that, in many cases, job training programs may make considerably more demands than the jobs themselves on literacy skills, because they involve the complex strategies used in studying to transform the store of information in textbooks into a store of knowledge in memory that can later be used to complete course examinations.

However, a more precise determination of reading demands of jobs is required if we aim to use such information in establishing objectives and curricula for education to provide students with the literacy skill levels needed to perform reading tasks in the world of work, i.e., to render students vocationally literate. In this case, what we would like to know is: What are the reading tasks people have to perform in various jobs, and what level of skill is needed to perform those tasks?

In the research conducted for the Navy described earlier, we attempted to develop an inventory tool which job analysts could use to (1) identify the reading tasks people perform in various jobs, and (2) determine the percentage of people reading at different skill levels, expressed in reading levels, as determined by a standardized reading test, who could be expected to accurately perform the job reading tasks.

A detailed discussion of the methodology, and a critique of several different methods for estimating reading requirements of jobs is presented elsewhere (Sticht et al., 1976). Here I will briefly summarize the outcomes of our efforts, and discuss certain methodological difficulties inherent in any attempt to define literacy demands of jobs, and hence in establishing competency levels for vocational literacy.

Defining job reading tasks. To define job reading tasks, we used the reading-to-do tasks identified in the interviews with Navy personnel in ten different jobs, as mentioned earlier. For the purposes of developing the inventory, we grouped the ten jobs into three clusters, as shown in Figure 6.

The next step in our procedure was to identify (1) the type of information sought in performing each task, and (2) the type of display in the reading materials, classified as either text, which would be written language; figures, including line drawings, photographs, schematic diagrams, etc.; tables, including both numerical and verbal tabulations; texts plus figures; texts plus tables; and tables plus figures.

This analysis revealed that the type of information sought was usually some type of factual data, or the person was trying to find out how to do something. Thus, categories of skills called fact finding and following directions were identified (see Figure 6).

Analysis of the reading-to-do tasks for students, instructors, and job performers, summed over the three vocational clusters, showed that 110 were fact finding and seventy-six were following directions tasks. Instructors and job incumbents utilized fact finding skills two to four times more than following directions skills, while students used following directions skills twice as often as fact finding skills (though this differed in the data oriented jobs).

1. The ratings were grouped into three job clusters.

2. The reading tasks within each job cluster were classified by the type of reading skill utilized in seeking the information.

3. Within this classification, the reading tasks were further classified by the type of reading displays.

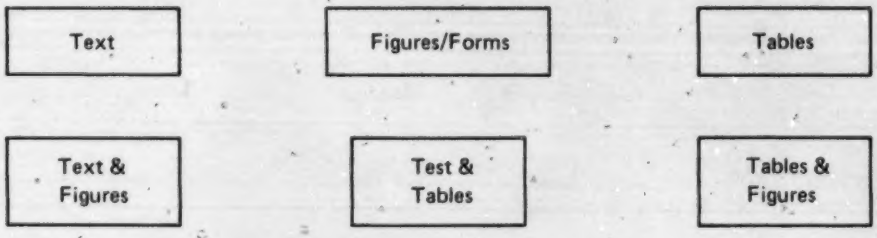

Figure 6. Procedures for defining job reading tasks.

Analysis of materials by display types revealed that the combination of tables plus figures was very rarely used; hence this type of display was not used in the subsequent research. Texts constituted the most frequently used type of display and made up about one-third of the display types, with figures running a close second at somewhat less than 30 percent of the display types. Tables, texts plus figures, and texts plus tables fell in that order of frequency of occurrence behind texts and figures.

There were differences among types of jobs in the relative frequency of uses of displays, with technical maintenance jobs using proportionately more figures and data oriented jobs using figures and tables to about the same extent.

The reading task inventory. By means of the classification system outlined above and presented graphically in Figure 6, generic reading tasks were defined as the application of either fact finding or following directions skills to texts, figures, tables, text and figures combined, and text and tables combined. Tasks comprised of the two skills applied to the five display types were found in all ten of the jobs making up the three career clusters of Figure 6. They therefore represent, at an abstract level, the types of Navy reading tasks Navy personnel perform in the course of doing a job. In an abstract manner, this analysis answers the question: What are the reading tasks people have to perform in various jobs in the Navy? We can answer, they look up facts in texts, they look up directions in texts, they look up facts in figures, they look up directions in figures, etc.

Conceivably, we could develop an inventory by simply asking people whether they look up facts in texts, figures, tables, etc. In fact, in work for the Department of Manpower and Immigration in Saskatchewan, Smith (1975) and associates used a somewhat similar inventory approach in which they attempted to discover both what kinds of materials were read in a number of occupations (e.g., notes, memos, letters, directions, instructions, policy manuals, and the like) and what reading tasks are performed in those jobs (e.g., read to locate facts, to follow directions, to discover the main idea, etc.). To obtain this information, interviewers at times showed displays of the general type of material they were talking about. For intance, in determining if a given job required the reading of graphs, two graphs were shown as exemplars and interviewees were asked to indicate whether they read similar graphs in performing their jobs.

A problem with the inventory approach in which people simply indicate whether they read some type of material is what it fails to distinguish among complexities of materials, and it provides no indication of the level of general reading skills required to perform the set of reading tasks in a given occupation.

To overcome these difficulties in the Navy research, a reading task inventory was constructed which included three levels of complexity for each type of display, i.e., texts, figures, tables, etc. The displays were taken from the Navy's *Bluejacket's Manual.* This 617-page manual is the basic manual for new Navy recruits. Therefore, it is meant to be read using only general reading skills and knowledges, and its content is familiar to all Navy personnel. These features are important because a primary type of information desired for occupational reading requirements is "Data on the level of reading skills required to have access to the occupations."(Miller, 1974). Since *The Bluejacket's Manual* is an entry level manual, it represents the type of material that one must be able to read to have access to all Navy job training and occupational fields.

To develop an inventory that we could use to identify the kinds of reading tasks people perform, and the general level of reading skill needed to perform those reading tasks, we searched *The Bluejacket's Manual* to locate three concrete instances of each of the five abstract categories of generic reading tasks identified in Figure 6. Three examples of each generic reading task permitted us to use three levels of complexity for each reading task. These levels were confirmed by two judges.

Figure 7 provides an example of the type of display included in the inventory. On the left-hand side is a sample of text plus table material from *The Bluejacket's Manual.* On the right-hand side are the inventory questions. This particular page from the inventory is for fact finding, so job incumbents are asked: In your job would you ever have to perform reading tasks using material like this to look up facts? If they said yes, then they were asked questions about the frequency of performance, and then questions about the consequences of making a reading error in performing this kind of reading task. These data are used to make decisions about the criticality of the reading task.

To identify the general level of literacy required to perform each reading task, we wrote fact finding and following directions questions for each of the display types in the inventory. These job reading tests were administered to a sample of Navy recruits. Additionally, they were administered a standardized reading test. With these two sets of data, we could then determine how well young adults of differing reading skills could perform the job reading task test items.

Figure 8 shows the results of asking a following directions question using the same material as shown in Figure 7 as a fact finding inventory item. This type of display shows the job reading material on the left side of the page, and presents the type of task, the form (in this case E for easy), the question, and the test results, i.e., the percentage of personnel at each general reading grade level who got the correct answer to the reading task test item. In the case of Figure 8, we see that ten persons read at the sixth grade level, and 40 percent of them got the answer to the question correct, using the material on the left side of the page (in the actual text, the material was in *The Bluejacket's Manual.* Thus people had to locate the material in the 617-page manual. They were given page numbers. By using the intact *Bluejacket's Manual* we hoped to obtain a greater fidelity to the actual job reading situation).

At the bottom of the right side of the page the results of the use of the material in the inventory format are presented. For our exploratory study, only four persons from four jobs tried out the inventory. The results show differences in the reported frequency of use by these four personnel for this type of material. Obviously, large numbers of personnel are needed to obtain a reliable, normative view of the performance of various reading tasks in different jobs.

To see how general reading skill is related to performance of the job reading tasks considered as a set, Figure 9 shows the percentage of job reading test items with percent correct scores of 50 percent or less for each reading grade level group. The figure shows that for all of the reading tasks attempted by sixth grade level readers, 42 percent of the tasks had accuracy rates equal to or less than 50 percent. The proportion of reading tasks having this accuracy rate decreased to a low of 6 percent averaged over persons with twelfth, thirteenth, and fourteenth grade reading levels. Thus, the probability that more than half of the people at a reading grade level of skill will be able to perform a given reading task shows a seven-fold decrease from the twelfth to fourteenth grade level reading skills to the sixth grade level!

To identify the reading demands of any Navy job using this inventory approach, one would first administer the inventory to job incumbents to determine frequency and criticality of performance of each reading task. Then, to determine the reading grade level of difficulty for each type of reading task in the inventory, the job analyst would consult expectancy tables which show how well people of differing reading grade levels perform the reading task. At this point, a management decision must be made about what percentage of people should be able to perform the reading task. If it is determined that only 40 percent of the people should be able to perform the task, then, by using Figure 8 example, a sixth grade level of reading skill would suffice, and the task would be assigned a value of sixth grade level of difficulty. However, if it were determined that 80 percent of the people should be able to perform the task, then in the example of Figure 8, it is at the eighth grade level

All ships are assigned *designations*—a group of letters which indicate their type and general use—and *hull numbers*, which are usually assigned in sequence to ships of a type as they are built. These identifying designations are used in correspondence, records, plans, communications, and sometimes on ships' boats, because letter and number designations are shorter than the ship's name—*Mission Capistrano*, (AC 162)—and help to avoid confusion between such similar names as *Home* (DLG 30) and *Hornet* (CVS 12) or *Phoebe* (MSC 199) and *Phoebus* (YF 294).

The first letter in a designator is a general classification: *D* for destroyers, *S* for submarines, *L* for amphibious vessels, *M* for minewarfare vessels, *A* for auxiliaries, *W* for Coast Guard vessels, *T* for Military Sealift Command ships, and *Y* for service and yard craft. In combatant designations, the letter *N* means nuclear powered and *G* means the ship is equipped to fire guided missiles. A listing of most ship designations follows; minor yard craft and service craft have been omitted.

AD	Destroyer Tender
ADG	Degaussing Ship
AE	Ammunition Ship
AF	Store Ship
AFS	Combat Store Ship
AG	Miscellaneous
AGDE	Escort Research Ship
AGEH	Hydrofoil Research Ship
AGER	Environmental Research Ship
AFG	Miscellaneous Command Ship
AGM	Missile Range Instrumentation Ship
AGMR	Major Communications Relay Ship
AGOR	Oceanographic Research Ship
AGP	Patrol Craft Tender
AGS	Surveying Ship
AGSS	Auxiliary Submarine
AGTR	Technical Research Ship
AH	Hospital Ship
AK	Cargo Ship
AKD	Cargo Ship Dock
AKL	Light Cargo Ship
AKR	Vehicle Cargo Ship
ANL	Stores Issue Ship
AO	Net Laying Ship
AOE	Oiler
AOG	Fast Combat Support Ship
AOR	Gasoline Tanker
AP	Replenishment Oiler
AR	Transport
ARS	Repair Ship, Salvage Ship
AS	Submarine Tender
ASPB	Assault Support Patrol Boat
ASR	Submarine Rescue Ship
ATA	Auxiliary Ocean Tug
ATC	Armored Troop Carrier
ATF	Fleet Ocean Tug
ATS	Salvage and Rescue Ship
AV	Seaplane Tender
AVM	Guided Missile Ship
CA	Heavy Cruiser
CC	Command Ship
CCB	Command and Control Boat
CG, CGN	Guided Missile Cruiser
CL	Light Cruiser
CLG	Cruiser

(1) In your job would you ever have to perform reading tasks using material like this to look up facts?

(2) How *frequently* do you perform a reading task similar to this?

1	2	3	4	5
1 to 3 times a year	1 time each month	2 to 3 times a month	1 or more times each week	Daily

(3) What might be the consequence of a reading error with this type of reading task?

1. No consequence.
2. I would be disciplined and some time would be wasted.
3. The job would have to be done over again and some time would be wasted.
4. The job would have to be done over and some material would be wasted.
5. The job would have to be done over and some people would be inconvenienced.
6. Equipment would be damaged or lost.
7. I might be injured or other personnel might be injured.

Figure 7. Sample page from the Navy Reading Task Inventory.

All ships are assigned *designations*—a group of letters which indicate their type and general use—and *bull numbers*, which are usually assigned in sequence to ships of a type as they are built. These identifying designations are used in correspondence, records, plans, communications, and sometimes on ships' boats, because letter and number designations are shorter than the ship's name —*Mission Capistrano*, (AC 162)—and help to avoid confusion between such similar names as *Home* (DLG 30) and *Hornet* (CVS 12) or *Phoebe* (MSC 199) and *Phoebus* (YF 294).

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AD	Destroyer Tender	AO	Net Laying Ship
ADG	Degaussing Ship	AOE	Oiler
AE	Ammunition Ship	AOG	Fast Combat Support Ship
AF	Store Ship		
AFS	Combat Store Ship	AOR	Gasoline Tanker
AG	Miscellaneous	AP	Replenishment Oiler
AGDE	Escort Research Ship	AR	Transport
AGEH	Hydrofoil Research Ship	ARS	Repair Ship, Salvage Ship
AGER	Environmental Research Ship	AS	Submarine Tender
AFG	Miscellaneous Command Ship	ASPB	Assault Support Patrol Boat
AGM	Missile Range Instrumentation Ship	ASR	Submarine Rescue Ship
AGMR	Major Communications Relay Ship	ATA	Auxiliary Ocean Tug
		ATC	Armored Troop Carrier
AGOR	Oceanographic Research Ship	ATF	Fleet Ocean Tug
		ATS	Salvage and Rescue Ship
AGP	Patrol Craft Tender		
AGS	Surveying Ship	AV	Seaplane Tender
AGSS	Auxiliary Submarine	AVM	Guided Missile Ship
AGTR	Technical Research Ship	CA	Heavy Cruiser
AH	Hospital Ship	CC	Command Ship
AK	Cargo Ship	CCB	Command and Control Boat
AKD	Cargo Ship Dock		
AKL	Light Cargo Ship	CG, CGN	Guided Missile Cruiser
AKR	Vehicle Cargo Ship	CL	Light Cruiser
ANL	Stores Issue Ship	CLG	Cruiser

NAVY READING TASK TEST/INVENTORY–RESULTS OF EXPLORATORY STUDY

Type of Task: Following Directions Using Texts and Tables (Form E, Item 16)

Question: *Situation* – You are on watch and have been told to report all ships that you see. When reporting, you have been told to first give the ship's general classification and then the designation. You have sighted a light cargo ship.

What do you report?

Test Results: Percentage of personnel at each reading grade level who got the correct answer.

READING GRADE LEVEL

	6	7	8	9	10	11	12	13	14	TOTAL
N	10	8	7	8	11	8	7	6	17	82
%	40	50	86	62	55	62	71	83	82	66

Inventory Results: Frequency with which this type of task is performed.

	1 1 to 3 times a year	2 1 time each month	3 2 to 3 times a month	4 1 or more times each week	5 Daily	Not Used
Electronics Technician		x				
Electrician's Mate				x		
Gunner's Mate						x
Boatswain's Mate						x

Figure 8. Performance of personnel of various reading grade levels of ability on a test of following directions using text and tables.

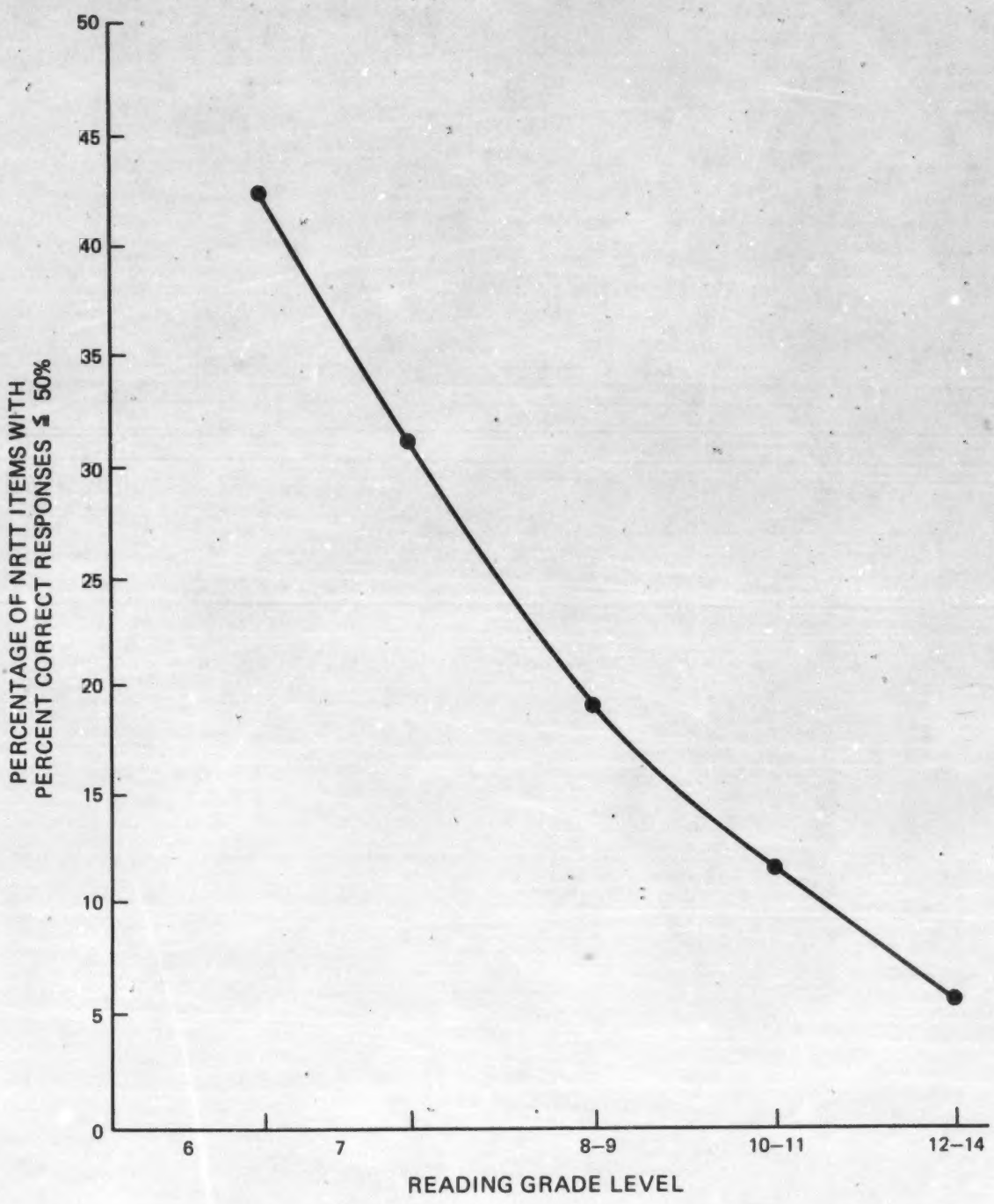

Figure 9. Percentage of NRTT items for which correct responses were obtained by 50% or less of the people at a given reading grade level on the Nelson-Denny test.

where 80 percent of the persons first get the item correct (it is assumed that with larger numbers of persons taking the test, the fluctuations in the percentages correct as a function of reading skill level would be greatly reduced). This would then cause the item to be assigned an eighth grade level of difficulty.

To determine the reading difficulty for a job, the reading grade level of each reading task indicated as being performed on the job in the inventory of job reading tasks is weighted by its frequency and criticality. These weighted figures are summed and the average weighted reading difficulty level is computed. The resulting average reading grade level is the level of general reading skill that is needed, on the average, to perform the reading tasks of a given job.

Critique of the reading inventory approach. In any approach to the development of an assessment instrument to evaluate the skill/knowledge levels required for successful performance in a domain, a variety of methodological and procedural problems is encountered. The experimental development of the Navy job reading task inventory is no exception. A discussion of some of these problems may be instructive for others who would set out to identify reading demands or "minimal competencies" for vocational literacy.

Key requirements of the inventory are that job incumbents respond to the generic aspects of a task display rather than to the specific content; that they respond to the levels of complexity; and that they respond to the distinctions between fact finding and following directions. In the research described, however, no good basis was established for assuring that the levels of complexity or types of uses (fact finding, following directions) actually entered into the interviewee's responses. There was evidence that indicated that, of the four people who tried out the inventory, two did not respond only to the generic aspects of the displays, but rather they responded in part to the specific content. In the work by Smith (1975) this was not reported to be a problem. But neither was it detectable because of the methodology used in that study.

Concerning the job reading task test, aside from the technical problems involved with some items, which could be remedied by careful redesign of questions, a major problem is in knowing how close the reading task questions approximate the real job reading tasks. It may be that the reading test imposes unrepresentative information processing demands which are not involved in the real life execution of job reading tasks. Indeed, the most difficult question to answer is that of the validity of the reading inventory/test as a measure of the reading demands of jobs. Is there any way to be certain that this entire procedure presents a valid estimate of the reading demands of jobs? This raises the question of how would we know? It may be easier to know that an approach is not valid than to know that one is. For instance, the approach in which a readability formula is applied to a sample of text materials is an empirical method for determining the average reading difficulty level of materials. However, the question of validity seems clear with the readability approach: it in no way involves figures and tables in the estimate; and, as we found in the Navy research, only some 30 percent of the reported reading tasks involved texts only; two-thirds used figures or figures and texts combined.

In a review of some seven different approaches for estimating the reading demands of jobs, Sticht & McFann (1975) show that all seven approaches provide different estimates. Indeed, the very definition of a reading task differs from one to the other approach. From the present discussion, and the analysis of Sticht & McFann, it should be apparent that there is no such empirical "condition" or "event" or "thing" known as "the reading demands of a job." Hence, there is no one "true" way to establish "minimal" competency levels of literacy for vocational preparedness. Reading demands of jobs are not to be discovered; rather they must be created by procedures which are more or less systematic and are performed according to more or less specifiable rules. The

question of the validity of any estimate can only be answered in respect to a model or theory of job-related reading which would define systematic procedures for obtaining estimates of reading demands of jobs for various purposes permitted by the theoretical constructs involved.

It should be noted, however, that the foregoing problem of validity is not specific to the determination of job reading requirements. Indeed, they permeate all aspects of job and task analysis, and all psychometric approaches to the evaluation of skills and knowledges in any domain of activities. Within these limits—and they are imposing and formidable limits, which ought to be conducive to humility among psychometricians, job and task analysts, and educators—I believe that the inventory approach can, with refinements, offer useful information about the reading demands of jobs, and contribute to the development of more useful vocational literacy training programs, to permit higher levels of vocational competence.

Summary

In this paper I have discussed literacy and vocational competency, with an emphasis upon the need to have a more profound understanding of what we mean when we talk about literacy, and the relevance of our understanding of the nature of literacy for studying reading in vocational settings. In the context of a developmental model of the acquisition of literacy, I pointed out that reading may be considered a second signaling system for speech. Therefore, people who become literate learn to perform tasks with written language which they previously could perform only with the spoken language. This "gap" between skill in receiving information by ear and by eye was evidenced in interviews with personnel with different reading skills in military jobs. Poorer readers tended not to use written language as much as they did spoken language to get job information. As reading skill increased, there was a greater tendency to use written language for job information.

A second view of the written language was offered that pointed out that written language differs from spoken language in two critical ways: it is permanent, and it is capable of being arrayed in space. Because of these features, written language can be consulted as an "external memory," and hence reading-to-do tasks are possible. In these, a person reads to obtain some information which can be immediately applied and then forgotten. If needed again, it can be looked up again. Additionally, the permanent nature of print permits reading-to-learn tasks wherein written material is studied, and the information in the material is transferred to the memory of the reader for subsequent use.

The importance of the fact that written language can be arrayed in space showed up in analyses of materials used by job incumbents where it was found that two-thirds of the reading tasks involved figures or figures plus textual material. Such figures usually include written language placed as labels at various points in space, and the reader searches the visual space for information.

An exploratory study was discussed which attempted to use reading-to-do tasks—looking up information in texts, figures, tables, and combinations of these materials—to develop a job reading inventory that could be used to (1) identify the reading tasks people perform in various jobs and (2) determine the level of general reading skill needed to perform the job reading tasks. Results of the study showed a strong relationship between reading ability and ability to perform job reading tasks, with persons who read at the sixth grade level performing only one-seventh as well as those reading at the twelfth to fourteenth grade levels. Yet, more than half of the reading tasks were performed correctly by more than half of those reading at the sixth grade level!

A critique of the inventory approach to understanding reading requirements of jobs revealed that significant questions remain unanswered regarding the validity of the approach. The need for

solid theory also was noted, so that methods of assessing vocational literacy competencies which have construct validity might be developed. In the absence of a sound theory of literacy in vocational settings, any approach to establishing "minimal competency" levels for ensuring that students achieve literacy skills needed for successful participation in a meaningful vocation will remain largely arbitrary and open to skepticism.

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QUESTIONS AND ANSWERS

Question: What kinds of implications do your last comments about competence have for the typical instructional strategies requiring competence at a certain level before proceeding to the next competence? Do you have any feelings about modularized instruction or competency-based learning or the typical idea of 80 percent proficiency on Task A before attempting Task B?

My unfortunate predicament is that I suspect that somehow that isn't the best strategy in the world, but I don't know exactly what else to do. That's a predicament into which we get ourselves often. I can fall back on the need for more research, but people who must develop programs don't have that as an out. The idea of the individualization of instruction is made somewhat difficult to implement if we don't really try to understand what knowledges and capabilities students have and how we can develop activities we would like them to perform to stimulate growth in these mental resources.

I think we do have some possibilities for doing a better job. For instance, we can use computers to really begin to understand what people understand. We are funding research now on computer programs that enter into Socratic dialogues with students. Such programs talk with students and ask questions of them that they can answer. The computer doesn't have an active-memory problem or retrieval problem. It always goes back into its own "head" and remembers what the person said and begins to develop a conceptual knowledge base about that particular student. It's useful, then, to pull out of that student the knowledge related to the question to be answered. That leaves out the problem of the distinction between skill and knowledge. This is another of those areas where we still are conceptually clumsy.

To me, skill refers to how well you do something, not to the something you end up doing. It has to do with the efficiency of the performance; that is, do you do it quickly? do you do it slowly? It has something to do with the quality of performance; is it done in a halting, hesitating manner? For instance, though I could play the piano for you, I am sure you would not conclude from my performance that I had a high level of skill in playing the piano! You would admit, I think, that I was indeed producing a tune, but not in a very skillful manner. You even could draw some conclusions about the kind of explicit knowledge I had. In fact, if it were explicit you could ask me. But, we have no direct way of talking about the act itself, that is, about the assembly of motor neurons in the body and all that permits me to put everything together into whatever performance it is.

One way this has been talked about has been in terms of implicit knowledge, that is, knowledge of which we're unaware. I got sidetracked on that for some time when I started reading in linguistics. I kept reading about knowledge that people have of grammar and, to me, knowledge was something you knew about to the point that you could talk about it. But I learned later on that what Chomsky had in mind when he talked about knowledge was that this is implicit knowledge; that is, because you can produce a sentence, you assume the brain has the knowledge to produce a sentence. I can understand that, but it was a difficult concept for me. But that's what is

meant by implicit knowledge—not that you know explicitly the rules of grammar and these tell you how to generate a sentence. Most of us don't know those kinds of things. But, since we can talk, the linguists conclude that our brains know the rules of grammar, even if we don't. I think they're right to a large extent. We clearly do all kinds of things without knowing how we do them. If it were not so, why would we have to spend so much time analyzing tasks? Given that so much of what we draw on to learn and perform tasks is implicit knowledge, it's difficult for me to imagine how we can put together a competency-based program to develop implicit knowledge.

There are two major problems. One is seeing that people get all the practice they need to develop skill in the use of knowledge that we can give them. That means a lot of drudgery, a lot of time, and a lot of practice. The other problem is teaching the implicit knowledge which, by definition, is almost unteachable. Yet, I think implicit knowledge might be what everybody implicitly recognizes as the mortar that's holding our task "bricks" together.

Question: I'd like to go back to the statement you made about the minimm level of competency for entry level tasks as being spurious and very difficult to work with. In view of the fact that there are probably 30 state legislatures working on some kind of high school graduation requirements or some way of measuring minimum competency for high school graduation, how can you relate this problem to the desires of society?

I mentioned one approach to minimal competency in reading, and that is to insure that people can use written language with the same efficiency and effectiveness as they can the spoken language. Of course, if their oral language is not developed well, then you do have the problem that they will not do so well in the written language. But at least you'll know what you're dealing with—that the printed language is not the major source of difficulty. One of the problems frequently encountered in assessment is that when people score low on a reading test, we conclude that we must teach them to read. This may not be true at all. We might want to give them all those experiences they haven't had—let them experience the world. We might want to help them talk about the world, develop a conceptual understanding of the world. Then, if they could do that and learn to use print as a second signaling system, they would have access through printed language to the conceptual base that they also access through spoken language.

A second approach to minimal competency in reading is to simply ignore most of what I've said and to treat the problem from a psychometric point of view. By this approach, we would scale reading ability, build reading tests, and administer the tests to people. Let's just use norm-referencing for the time being. That's a good way to build a scale. You could talk about a test that has a first-grade, second-grade, fourth-, fifth-, sixth-grade level, and about how people at each of these levels do. You could then identify and collect a lot of job-reading tasks. Then you could administer the reading test and find out what proportion of people who read at the sixth-grade level can do each reading task, what proportion of people reading at the seventh-grade level can do it, and so forth. Let me tell you what you might end up with if you did that. We did it, as a matter of fact, for the Navy. Through interviews with Navy personnel in different jobs, we identified various kinds of reading tasks. We then made reading-task tests. We simply xeroxed the material they said they read and we found out how they were trying to use it. Were they trying to get a piece of information out of it, or follow directions? We asked them questions like that. We found that printed text frequently is not used alone. It is used in conjunction with graphics. In fact, two-thirds of the reading tasks we identified involved the use of tables and texts together or figures and texts together. Only one-third involved text per se. Using the types of materials people reported using, we developed job-reading task tests and administered them to Navy personnel.

Then, we gave them the Nelson-Denny reading test. We were then able to find out how well people of different reading grade levels of skill were able to perform specific Navy reading tasks. For one task involving fact finding, we found that 80 percent of the people reading at the sixth-grade level could use a Navy document to find the answer to a question. We obtained such information for many reading tasks. In fact, there is no end to the number of Navy reading tasks tests one can build, which is one of the problems.

In addition to fact finding questions, we developed what we call a following directions reading test. One of the problems in developing following directions tests is that when people perform tasks on the job, they frequently already know how to do the task, except for one step or, maybe two. So, how do you stimulate people who have some information, but don't know what to do next? That's what we tried to do. We gave them a situation and then we said, What do you do next? They had to get the information from Navy materials. In one case, only 40 percent of the people at the sixth-grade level, 50 percent reading at the seventh-grade level, and up to 83 percent at the twelfth through fourteenth levels, answered this kind of question correctly. We also found, with the small numbers we were using, that people reading at the tenth grade level performed less well than those reading at the eighth grade level.

But that's the problem with psychometrics, you know. Nothing is perfect. The Nelson-Denny reading test doesn't do a perfect job of classifying people. Neither does the job reading task test. My guess is, with larger numbers, job reading task performance would turn out to be an increasing function of general literacy. That would be the hope anyway.

In the Navy report, we review about seven or eight different ways we might go about trying to establish the reading demands of a job. A readability approach, which involves using a readability formula to estimate the reading level of difficulty of materials, is a frequently used approach. However, it has its problems. For one thing, it doesn't deal at all with tables and graphic forms such as the kind I mentioned earlier. This produces a problem of validity. How do we know we have a valid estimate of the reading demands of the jobs? My guess is that we will hardly ever know that. What we can be pretty certain of, though, is what isn't valid—which means we have a lot of work to do because we can always keep excluding things. As I say, since readability doesn't account for the graphics, we know it is not a valid overall indicator of the literacy demands of a job.

Another approach reviewed in the Navy report involved having people take a job sample test. In the case of cooks, for example, we analyzed what it takes to make a jelly roll. Then, we had 400 cooks cook jelly rolls in a job sample test. We also administered reading, arithmetic, and listening tests so that we would find the correlation between job sample test performance and performance on the basic skills tests. We did the same thing for other job performances: vehicle repair people repaired vehicles; supply clerks worked in a little mockup supply room; armored crew members drove tanks. In addition to the job sample tests, we also gave paper-and-pencil job-knowledge tests based on what job incumbents told us that they *had* to know, not what is nice to know. We built job-reading tests and we gave them. Finally we obtained supervisors' ratings of proficiency. The correlations of a general reading test with those different criteria help us to understand the contribution of the reading component. It's a way of partialing out contribution of reading skill to job proficiency. Supervisors' ratings of traits such as dependability, honesty, utility, godliness, and cleanliness, and those kinds of characteristics do not require the performer to exhibit reading competencies. So, we would expect such ratings to have fairly low correlations with reading test scores.

It turns out the correlation between supervisors' ratings and reading test scores is about .15 to .20. Now, if you correlate the reading test with a job-sample test in which the person must at least

be familiar enough with language to receive the instructions to do the task, the correlation goes up to .30. If you then give the paper-and-pencil job-knowledge test, you're beginning to make a direct demand on that competence you hope you're measuring with your reading test. The correlation goes up to .50. If you then give that general reading test and a job-reading test, the correlation goes up to .6 to .7. If you then correlate that one general reading test with another general reading test, the correlation goes up to about .80. I think there is a methodological note here which points out that whether or not reading is related to job proficiency depends on the criteria for job proficiency. A criterion which involves reading will require reading! If the criterion does not involve reading, the correlations will shrink. They may be low, but they may be useful. For instance, even with a correlation of .30 or .50, you can construct expectancy tables. We did that for cooks, armored crew members, vehicle repair people, and supply clerks. We computed the probabilities for several groups that a person reading at grade level four to five-nine will be in the bottom quarter on job sample test performance. For cooks, it was .34; for armored crew members, .32; repair people, .26; supply clerks, .40. The job-sample performance in supply uses about as much reading as a reading test does. It's mostly filling out forms.

Having decided that you can measure the reading requirements of jobs, you then might wish to set a goal for general literacy. By now, I'm sure you understand that what I said is a non-entity. General literacy is the name we use because we don't care to discuss all the specific knowledge and competence that people have. It's useful in these kinds of conversations as long as nobody believes it. At any rate, if you wanted to set your goal for general literacy, you could say it would be nice if reading skill were such that people were not likely to be overrepresented in the bottom quarter. So, you would look for the reading grade level where there were 25 percent or fewer of the people in the bottom quarter. If you do that in the data being discussed, it comes out to be seventh-grade level for cooks on both the job-sample and job-knowledge tests, eighth-grade level for armored crew members and repair people, and ninth-grade level for supply clerks. Those probably are totally invalid estimates of what it takes to do the reading required in those jobs.

In one sense, of course, the competence required to perform the job-reading task, is simply to perform the job-reading task. It has no level to it. You simply must be able to perform those kinds of tasks, if we could figure out what those kinds of tasks are. I think it is a fruitful field for research. I think it ought to be accompanied by a fairly sustained and prolonged level of conceptualizing—deep thinking. I suspect that one of the things we know about the state legislators and about the push for competence is that what will happen, despite our lack of intellectual understanding, is that people will build some kind of indicators. Those indicators will be disagreed with by some and agreed to by some others. Then, we will continue to try to find new and better ways to understand what people are learning to do, but interim measures will be taken; tests will be built. People are cracking out survival tests. We're doing it with just as much ignorance as we ever did before. We rise to that challenge.

Question: This may be a hypothetical question. Assume that this kind of presentation were given to a congressional subcommittee considering funding government agencies such as NIE, and one or more of those Congress persons said respectfully, but firmly, so what? What kind of answer would you give?

I guess what I would do is explain that this country's schools are trying to deliver educational services to a wider variety of people to make them more capable than we have ever been able to do before. Everything I've been saying is simply to be able to understand what it is you are trying to do. These would be foreign ideas to many of the people on the Hill; that is, trying to understand

what they are trying to do. But nonetheless, that's what we would try to do. My approach to them would be somewhat different. I would have whipped out those job-reading tasks that I showed you right there and would have introduced that fine product which now we are going to enrich through further R&D. I think, though, that we do have a real problem in communicating with the people on the Hill. We have a real problem understanding ourselves. We have a lot of talk about back to basics. Well, that talk is going on at a time when, as far as I can understand from studying the statistics, the schools are trying to deliver not only equality of educational opportunity (equal access) for good quality education, but also seem to be moving toward equality of achievement. To my knowledge, we have never had a school system that could do that, especially when the system also is being asked to mainstream people whose learning rates and problems of learning are drastically different from others. We're being asked to do it with bilingual people and multilingual people, who may not even know the teacher's language of instruction. We're being asked to deal with people who may be in for two weeks here, three weeks at another school, a very migrant population. In terms of a set of basics to go back to, there never were any basic instructional or organizational methods for dealing with this situation. There's never been a nation on the face of the earth that ever did that. We don't have anything to go back to. We might as well go forward. Notice particularly this problem of evaluating the criterion. Look at what we've done. We've tried to assure equality of achievement. We've jacked up the quality, by the way. It used to be that the criterion for literacy was whether you could sign your name. That won't go anywhere today. That won't do anything for you. We have also tried to extend these very high levels of literacy to a wider population than we did before. I think that augers wells for R&D.

Question: You raised the question of implicit knowledge and how we define competencies for something implicit. If we look at Chomsky's concept of a black box, he's really talking about a rule-formation device that's implicit essentially and which is triggered by experience. If we assume that the semantic domain also has a set of rules that are triggered into organizing by virtue of experiences we have, should we be asking questions like, "What kinds of experiences do we design to trigger rule formation to lead to the kinds of learning you're looking for?"

What you said in effect was that we need to understand understanding, and we know that the linguistic approaches like Chomsky's are unsatisfactory because they deal solely in the rarefied universe of an abstract grammar system. More recent approaches going beyond that involve semantics. That is an area that is blossoming right now. It goes well beyond grammar by taking pragmatics, the functional use of language, into account.

Let me close by giving a quick reference to a book by Bob Glaser that explains a Learning Research and Development Center program of research on adaptive learning. In his book on *Adaptive Learning* he talks about the kinds of concepts I have discussed here and how they apply them at LRDC to develop their new reading system. He also talks about how their thinking about thinking is going on. Also, the Center for the Study of Reading, at the University of Illinois, is exploring the role of implicit knowledge in reading and language comprehension. I think the kind of work being done in these two Centers brings together the theoretical and applied research that is needed for us to understand how personal competence is brought to bear in learning and performing in a diversity of settings, including the world of work.